UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/624,356	07/21/2003	Aaron Scott Lukas	06336P USA	7682

23543 7590 09/21/2005

AIR PRODUCTS AND CHEMICALS, INC.
PATENT DEPARTMENT
7201 HAMILTON BOULEVARD
ALLENTOWN, PA 181951501

EXAMINER	
PADGETT, MARIANNE L	

ART UNIT	PAPER NUMBER
1762	

DATE MAILED: 09/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/624,356	LUKAS ET AL.	
	Examiner	Art Unit	
	Marianne L. Padgett	1762	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 7/21/03 & 5/31/05.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-52 is/are pending in the application.

4a) Of the above claim(s) 36 and 46-52 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-35 and 37-45 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 21 July 2003 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 7/21/3, 5/31/5.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

1. Applicant's election with traverse of Group I, process claims 1-35 & 37-45 in the reply filed on 7/18/2005 is acknowledged. The traversal is on the ground(s) that to examine the entire application would not be a serious burden on the examiner. This is not found persuasive because compositions (claims 51-52) need not be used for the same process. For example, pore formers need not be used to form pores & can be materials, such as solvents, which would require review of a much broader range of literature than just the specific process. Similarly, the product need not be made by the same process, and considering how VERY broad product claim 38 is, reading on essentially any porous film that does not contain any Si-OH bonds, this would be an excessive burden compared to searching for processes that use UV in creating the porosity.

The requirement is still deemed proper and is therefore made FINAL.

2. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

3. The IDS of 5/31/05 & 7/21/03 are made of record, noting that the later is directed to references cited & reviewed in the parent, while in the former none of the references are prior art, except Zhengyuan et al who uses UV to make surfaces hydrophilic as by creating Si-OH bonds under unspecified, but probably oxidizing conditions, thus is not free of them.

4. Claims 1-35 and 37-45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In the independent claims 1, 28 & 38, the porous film is required to be "substantially free of Si-OH bonds", but since there has never been any possibility introduced of there ever having been any such

bonds in anyway associated with any phase of the process, it's not evident what this negative limitation is intended to exclude. Does it exclude some range of starting materials that might be used in film formation or require some effect of the exposing step, or should it just be taken as being extraordinarily broad (not a 112), such that any process that follows the basic steps, using any material, where UV radiation /curing may be involved & may apply, such as purely organic polymers that are foamed & never contained any Si, let alone Si-OH? These broadest possible options will be considered with respect to art for the claims as presently written.

In claim 2, it is unclear when this further treating takes place & if it is even distinguished from the "exposing..." limitation as it also may be UV light. Note claim 3 as written can include heating at any stage of the process where any of the film exists, such as use of a hot plate in processing, etc.

Use of relative terms that lack clear metes and bounds, unless clearly defined in the claims or in the specification or relevant citied prior art, is vague and indefinite. In claims 2 and 28, see "high" in "high energy"; in claim 9, see "hot" in "hot plate" & "modified" in "modified deposition chamber"; and in claim 12, see "small". In claim 8, what range does the units "picosecond" encompass with respect to "laser"? Is it 1-10 ps or 1-100 ps or 1-1000 ps or .01-1000 ps pulse times or what? "Sub-picosecond" might be considered to encompass all times below 1 ps, but for what is not specified, hence ambiguous or unclear.

When Markush groups and language therefore are employed, the species of the groups are suppose to be mutually exclusive, however in claim 4, "shuttered" might be a subset of "pulsed" (or simply not further limiting as it prevents exposure from occurring!), and either dispersed or focused can be either continuous wave or pulsed. In claim 8, some species in the Markush group of supposedly UV light (sources) are not even for UV, but emit visible or IR with no claim of UV being emitted, hence are contradictory & do not properly further limit. In claim 12, many of the various polymer species overlap,

as does the organic with most of the species. In claim 15, "chemical assisted vapor deposition", i.e. CVD, reads on or overlaps with any of the specific types of CVD also listed in this claim.

Claims 2 & 8 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. See above where options that make it so the claims are not necessarily further limiting are discussed .

In claim 9, some of the options do not make sense as written, i.e. "conducted in ... a hot plate". How does one get the film in the hot plate? The option of "a rotating turnstile" is also possible poor phrasing, as one unusually places the substrate on the holder, but in this case "in" might not be totally unreasonable.

In claims 11 and 42, 100% of what? The latter definitions of the subscripts used "atomic %", which is considered probable, but not necessary as written.

While not currently considered a formal problem by 1700 PTO management, the claims that refer to previous steps, such as 9, 16, 15, 20-22, etc "the ... step" limitations, and in 17 "the average size" are objected to as lacking proper antecedence due to inconsistent language usages with preceding claims.

Given that what materials the structure-forming and the pore-forming phases are made of is undefined or unspecified in claim 1, it is not clear that oxygen containing gases listed in claim 26, such as CO or CO_2 are necessarily "non-oxidizing atmosphere" as claimed, since they are capable of causing oxidation, depending on materials available for reaction, i.e. this limitation due to insufficient context has possibly contradictory or not further limiting limitations.

Claim 31 contradicts the requirements of claim 28, since "the porous film" is formed BY the EXPOSING limitation; it is impossible to preform treating of it before it exists. Due to its contradictory nature, this claim cannot as written be treated with respect to the prior art.

Claim 30, as is shown by claim 31, has potential conflicts in the exposing and treating limitations, since the treating is claimed to possibly be during some or <u>all of</u> the exposing, but the film is not porous until after or significantly into the exposing process. So treating with the second energy, in the scope as included by claim 31 can contradict the porous requirement.

Claims 30-31 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. See above contradictory options that do not properly further limit.

In claim 43 and 44, while "organosilane" and "organosiloxane", respectively, are further defined, these two generic categories are claimed in the alternative in independent claim 42, and never positively chosen in either of these dependent claims, hence as written need not necessarily ever be used.

5. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for

> patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1-35 & 37-45 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 2-26, 31-34, 38-45 & 50-54 of copending Application No. 10/295,568. Although the conflicting claims are not identical, they are not patentably distinct from each other because, while options are claimed in some different orders, and independent claims have varied emphases on energy source used with the broader photon source of (295,568) encompassing the UV of the present case, all the same options are present in each set of claims, thus creating obvious variations. The present 10/624,356 claims also have the requirement that the porous film be "substantially free of Si-OH bonds, but since in the most independent claims of either case, no silicon compounds or materials need ever be present, and as dependent claim 10 list choices such as SiC. SiN, SiCN, diamond-like carbon, which have no Si-O to form any –OH ligands thereon, this limitation is met, while in claims 42, using the same UV treatment on the same formed film (multiphasic

being equivalent to composite, given the same comprising limitations), would inherently provide the same effect or resultant composition, lacking any significant differentiation. For these reasons the differences as currently present in the claims, are obvious variations.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

7. Claims 1-8, 10-35, 37-38 and 41-45 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-3, 7-16, 19-24, 26-27, 32, 34-36 of copending Application No. 10/624,357. Although the conflicting claims are not identical, they are not patentably distinct from each other because these applications again have overlapping ranges of limitations, where the order in which limitations are further defined is different. For example, independent claim 1 of application 624,357 does not specify the necessary presence of the porogen required in all present claims, but dependent claim 15 does, as does the following independent claim 19, and where claim 24 of (357) further defines the porogen equivalently to present claim 14. The copending case's claims differ by having language requiring relative changes in hardness and elastic modulus due to the exposing/treating steps, however, as these are inclusive of the same such post-deposition steps as claimed in the present case, the same relative effect to what may be the same material, would have been expected to inherently occur. The (357) application also claims "substantially free of Si-OH bonds", hence is of overlapping scope for this feature also. It is noted, that while there claims are withdrawn, so not currently being examined, they are still pending.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

8. Claims 1-8, 10-15, 22, 25-28, 31-35, 37 and 41-45 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 2-3, 7-14, 16, 19-26 and 39-45 of copending Application No.10/379,466. Although the conflicting claims are

not identical, they are not patentably distinct from each other because copending case 10/624,375 which is the CIP child of 10/379,466, and discussed above in section 7, has claim substantially the same subject matter in the claims as its parent, hence the reasons for obviousness are the same.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

9. Claims 1-13, 15-16, 25-35 & 37 -45 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-14, 20-22, 24-27 and 30 of copending Application No. 10/842,503. Although the conflicting claims are not identical, they are not patentably distinct from each other because while various limitations are claimed in different orders, and with varying degrees of emphasis, the process limitations of these claims overlap in their generics and specific requirements, such that they are obvious variations on each other. While the present application emphasizes the post treatments to create the porosity and modify film characteristics, while 10/842,503 emphasizes the initial deposition & materials described therefore, however both require post-deposition treatment of film which may contain a porogen that is removed, where in the present case use of UV is specified & in (503) photon energy which is inclusive thereof may be used. It would have been obvious to one of ordinary skill in the art when employing photon energy to choose a wavelength(s) that is absorbed by the porogen to be removed, but will not significantly effect, i.e. be significantly absorbed by the structural component that is to remain, inorder to cause the effects claimed. As the porogens claimed in (503) are various hydrocarbons (mostly absorbs UV) & the structure silicate glasses (mostly transparent to UV), UV wavelengths would have been an obvious choice for particular photons to be used. Note while (503) doesn't claim that a non-oxidizing atmosphere is used during the photon treatment, it likewise dose not use an oxidizing atmosphere therefore, hence as written are of equivalent or overlapping scope.

10. Claims 1-16, 25-35, 37 and 42-45 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-5, 6-8, 13, 27-30 and 39 of copending Application No. 10/404,190. Although the conflicting claims are not identical, they are not patentably distinct from each other because while various limitations are claimed in different orders, and with varying degrees of emphasis, the process limitations of these claims overlap in their generics and specific requirements, such that they are obvious variations on each other. While the present application emphasizes the post treatments to create the porosity and modify film characteristics, the 404,190 application emphasizes the initial depositions, with both cases have overlapping claims to the areas the other emphasizes. Both cases, use "energy sources" to expose and treat the film in post deposition processing, where the present case is more specific by requiring ultraviolet light, instead of the generic "photon energy" of copending (190), however as photon energy would be directed to a photo reaction (as opposed to a thermal reaction which is a different species), one of ordinary skill in the art would have been expected to employ wavelength known to be photoactive with employed reagents or determine them by routine experimentation, hence the commonly employed UV for photoreactive processing would have been expected to have been effective, as also discussed in section 9 above..

With respect to the generic "rate enhancer" required in the reagents of the copending case, that may specifically be inert gases, these more specific deposition requirements are encompassed by the broader deposition limitations of the present claims. Also, it would have been obvious to one of ordinary skill in the art, that as the organic compounds employed in the present case's claims, which overlap with those (190), generally require or are used with carrier gases to enable CVD processing as claimed in both cases, that the use of such for their standard purposes would have been expected. Furthermore, as the CVD processing may be plasma CVD, which additionally employs inert gases, such as Ar, as plasma gas as well as carrier gas, the use of such gases would have been further motivated. Note that a gaseous component, such as inert gas, need not be labeled as a "rate enhancer" inorder to fulfill that function.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

11. Claims 1-35 and 37-45 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-6, 8-10, 13, 15, 17-18, 20, 22-23 and 61-67 of copending Application No. 10/409,468. Although the conflicting claims are not identical, they are not patentably distinct from each other because again, the various limitations in the two applications are claimed in different orders with different emphasizes and phraseology but overlapping generic and specific requirements, creating obvious variations. Again both cases have generic limitations to removing or exposing the film to form the porous films, with the UV (this case) & photons (468) post-treatment species overlapping. The 10/409,468 application claims photon energy, while the present case specifies ultraviolet, but reasons for obviousness as discussed in sections 9-10 above are the same. Other differences are generally semantic or equivalent phasing/descriptions or overlapping ranges. For example, claim 8 of (468) is describing a measurement technique that says the same results as claim 41 of the present case; claim 6 of (468) is giving a resultant density value as would have been expected for the relative densities of present claims 40-48. Claims 9 -10 comparison to a reference value has no clear meaning, so can be considered covered by the present case's claimed values.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

12. Claims 1-35, and 37-45 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-6, 8-10, 15-18, 33-35, 37-44 (45-46), 47-48 and 50 of copending Application No. 10/150,798. Although the conflicting claims are not identical, they are not patentably distinct from each other because copending case 10/150,798, the parent of above discussed 10/409,468, has claims commensurate in scope thereto, hence are obvious variations of the present claims, as discussed above in sections 9-11.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

13. Chung et al (6,231,989 B1) is of interest as discussed in the parent application, as. making a porous dielectric ceramic film that may or may not be fully free of C and/or H, where SiO_2 containing, Si-nitrogen-containing, Si-carbon-containing, Si-N-C-containing, and/or diamond-like carbon coating are contemplated (abstract; column 2, lines 54-65; and column 8, line 18-29). Various useful resin, exemplified by hydrolysable siloxane compounds are disclosed on column 3-4, where column 4, lines 55-67+ teach use of solvent in the deposition, such that at least 5 volume % remains after hydrolysis (contact with water and catalyst) to be used to form pores. A co-solvent technique, that uses a high boiling point solvent, such as various saturated or unsaturated hydrocarbons, exemplified by limonene, and an exemplary coating technique is spin-coating (column 5, lines 1-40, esp. 12 and 37). After hydrolysis (i.e. forming of the coating), the solvent is taught to be removed by any desired means (column 7, lines 40-44), where use of heat is specifically given, which may be preformed in vacuum or inert atmosphere such as N_2. It is also contemplated that the catalysis/H_2O step may be combined with the heating. Suggested modes of heating include oven, radiant or microwave energy, where while rate of heating is said to not be critical, it is preferred, to be as rapid as possible with heating under N_2 for 5 minutes-2 hours in an oven proposed (column 7, lines 40- column 8, line 17). Examples 1-4 use heating at various temperatures in vacuum or under N_2 for 10 minutes.

Chung et al, while teaching heating means that use photons in non-oxidizing environments, does not teach the requirement of the present claims that employ UV.

Zhong et al (6,596,834) teach porous dielectrics & creates their porosity by removing solvent during or after curing using vacuum or heat under inert atmosphere (N_2 or Ar), or likewise removing R-groups (ligands) form the structure material (like present claim 14), but while teaching any means of heating may be used, does not suggest UV as a source. Boisvert et al (6,872,456 B2) have analogous

disclosure (abstract; col.7-8 & 10), but while specifically mentioning radiant heating & preferring to heat as rapidly as possible & practical, does not mention UV.

Albano et al (2003/0054115: [0026-30+]; [0040-42]; [0058-59]; [0063]; & [0072]) who are specifically further treating porous dielectric films (like possibly in present claims 2 & 28-29) as taught by Chung et al, Zhong et al (6,596,834) or Boisvert et al (6,872,456 B2), all incorporated-by-reference, particularly taught treatment of exposed porous films with UV (in N_2 or Ar purged environment, optionally with N_2 or Ar H_2 or He process gases) and optionally post UV treatments, such as N_2, H_2, He or Ar plasma, or thermal treatments (abstract, [0074-0058]). The UV treatment of the porous material as described in Albano et al, is said to increase the elastic modules, with low dielectric constant values of 1.6 to 2.4 discussed. Further advantages of employing the further ultraviolet curing technique to the porous materials, as in Albano et al, are said to be improved chemical and dimensional stability. It is noted that Albano et al (115) suggest that plasma and/or UV may be alternatively used instead of heating to accelerate curing [0070], but none of the references, such as Zhong et al [0063-0070] or Boisvert et al [0072], discusses UV in curing or pore creation. Hence, the suggested additional use of UV cannot necessarily be said to be directed to the type of pore formation in atmospheric conditions as claimed, but has suggestions thereof as UV is employed in the creation of cured porous films to be further treated [0064-76, esp. 0070].

14. In Ball et al, see [0020-42] for discussions of porogens, such as dendrimers and hyper-branched polymers; [0014] and [0051-54] for their (quick) decomposition in from 5 minutes to several hours, with inert or reduced atmosphere using heat, such as exemplified by a hot plate; [0019] for host polymers, such as silsesquioxanes, etc., which produce structured compositions as claimed; [0013], [0050] and [0059] which provide pore sizes as claimed (about 10 Å to 100 Å, or 1-10 nm), with dielectric constants less than 3, or less than 2.2 mentioned; and [0055] which incorporates 09/906,276 = 2002/0102413 A to Han et al by reference for other steps that can be carried out on the resultant porous

film to improve the materials' properties by removing Si-CH_3 bonds, where claims 1 and 9 therein suggest plasma treating the porous film, where gases may be H_2, N_2, CF_4, O_2 or combinations thereof. Note that placing a substrate being heated to remove the porogen on a hot plate is inherently less than 1 foot from the energy source, but again these references do not recite claimed use of UV.

The literature article to Waldfried et al, "Single Wafer...Porous Low k-Materials", teach use of either plasma or UV (in N_2) assisted processes in improving the properties of porous low-k dielectric materials (abstract; Experimental; Table 1), but appear to be further treating already porous material and on p.228, 1st column, the UV curing discussion indicated that it creates Si-OH bonds (removable by subsequent furnace annealing), while the present claims require the UV exposed film to be substantially free thereof. It is noted that the publication date of the Waldfried et al reference lacks a month, so its status as prior art is uncertain, but all the references cited therein are pre-2002, and applicants' filing date of November 14, 2002 is late 2002, so will be assumed unless shown otherwise that this reference from the May 12, 2003 IDS is prior art.

15. Claims 1-12, 14-15, 17-30, 32-35 & 37-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raman et al (5,935,646), in view of Albano et al (2003/0054115 A1), discussed in section 13 above.

Raman et al teach forming a porous film using a mixture of polymeric materials, that may be considered multiphase as claimed, since the "at least one organic constituent" supplies an organic template, which is removed by energetic processing to create the porosity, and the at least one inorganic constituent" reads on an applicant's structure-forming phase, such as TEOS. Films are formed on substrates by spin-on or other liquid techniques. The porosity and size of pores is controlled by amount and size of organic template (organic liquids) to be removed, as well as atmosphere used during the removal (pyrolysis), which may be oxidizing (produce hydrophilic films), or may alternately for varying effect be a reducing atmosphere inclusive of Ar, N_2, H_2/N_2 or mixtures thereof (produce large contact

angles & hydrophobic films, see fig. 8-10 & col.12, lines 3-68, with line 37 noting the lack of Si-OH when treated in reducing atmosphere). Techniques taught for removing the organic ligands include thermal ones, O-plasma, or photolysis, where exemplary heating times in a reducing atmosphere are 0.5 hours. Taught pore size estimates include 0.19 nm for methyl templates and 0.34 nm for phenyl. In Raman et al, see the abstract; Figures, esp. 1, 2 and 3; column 4, lines 20-45; column 6, lines 4-14 (cyclohexane), 35-40 (spin coat) and 41- column 7, line 10 (porosity, pyrolysis, plasma, photolysis, etc); column 7, lines 31- column 8, lines 26 (more on template removal, pyrolysis and plasma); Examples 1-4 noting TEOS + MTES mixture as an exemplary multiphase coating, heated in N_2 in examples 1, 2 and 4; column 11, lines 20-26+; and column 12, lines 3-25 and 43-53. While Raman et al teach photolysis to remove template+ pore-forming material; they differ by not disclosing a recommended range of wavelengths, such as the claimed UV, or stating what atmosphere under, which the photolysis is preformed. Given Raman et al's teachings on use of atmosphere to control pore formation & surface characteristics when removing template material with the exemplary pyrolysis, it would have been obvious to one of ordinary skill in the art to employ like atmospheric conditions for analogous effects with the other recommended removal techniques, such as photolysis. It would have been further obvious to one of ordinary skill in the art, that for a photolytic process one must by definition choose a wavelength(s) capable of being absorbed selectively by the organic ligands one desires to remove as taught. UV would have been an obvious choice as hydrocarbon materials of which the organic ligands (col.7, lines 10-30) are composed, would have been expected to be absorptive thereof, especially in view of Albano et al (2003/0054115) who suggest the use of UV in the initial porous film formation of spin coated organosilicon materials [0070], that may also have ligands to be removed to create pores & who also teach that thermal removal is an alternative. Raman et al suggestion of photolysis for ligand or fugitive organic material removal, with Albano et al's suggestion of UV more generally used in an analogous phase of an analogous reaction, would have been suggestive to one of ordinary skill in the art

to use the UV for the pore formation in either pore formation scheme, given desired effects in both references & known absorptive characteristics, where choice of specific wavelengths would have been expected to have been dependant on particular reagents in use, so either known from reference texts thereon or determined from routine experimentation. Similarly treatment times would depend on amount of reagent, thickness, speed of reaction, but for photoreaction would have been expected to be quick, which is advised as desirable by teachings incorporated in Albano et al (2003/0054115 A1). Albano et al's teaching of further UV treatment to refine film strength & characteristic [0074-78], and Raman et al's similar subsequent heat treatment to further modify pore structure or the surface (col.8, line 14-26), both suggest desirability of further treatments involving energy to refine the product depending on desirer characteristic for final enduse.

Raman et al does not provide details on apparatus, chamber or substrate handling means or configuration, but applicant's widely inclusive list of such features includes those commonly required by multi-step procedures of the type taught by Raman et al, hence it would have been obvious to one of ordinary skill to provide such means for handling single or multiple substrates, for doing the sequence of steps in a single chamber or a series of chambers, according to economics, quantity to be processed, and practicality for a particular product.

Raman et al does not describe the deposits in an applicant's non-standard formula, however the silica related deposits with residual organics, etc, are of the type that would have been expected to have proportions ranging within those claimed, hence above arguments (sections 18, etc) again apply.

While Raman et al disclose no distances between coating and treatment sources, the examiner cannot think of any reason why energy sources for heating, plasma or photolysis would be further than applicant's smallest range of 1 ft or less, as processing is being done on relatively thin films at a microscopic level or molecular level with molecular size pores being produced. Efficiency of thermal,

plasma or photo treating would generally require separation distances of less than a foot in order to prevent energy loss or waste, etc.

While characteristic of & types of light sources are not taught by the combination, choice thereof would have varied with sources dependent on desired intensity, and blanket or patterned treatment which would have depended on enduse. Note applicant's claim 4, essentially covers all possible options, hence is inherently covered, since any light will use one named condition of the supplied light, while claim 8 names a wide range of UV lamps and lasers, including some that are not even UV, with excimer lasers and discharge lamps being standard sources of UV, hence expected options due to conventional usage.

16. Hacker (6,472,076 B1) is also creating porous organosilicon film, where curing techniques remove alkyl groups producing the porosity, hence is analogous to the mechanism of Raman et al & Albano et al, but uses CVD deposition techniques. Hacker teach treatments using heat, UV, UV+ heat or electron beam alternatively, where the thermal technique may employ ambient of air, N_2, N_2/Ar, H_2/N_2 at generally 400°C for 30 minutes, hence is further analogous with Raman et al & Albano et al, so is cumulative for the equivalence shown for use of thermal and UV techniques, that the photolysis taught by Raman et al & UV used in Albano et al, thus further shows UV would have been effectively used as suggested in Hacker. Note that Hacker teach use of oxidizing and non-oxidizing atmospheres alternately, which is consistent with Raman et al, and that while use of moisture containing atmosphere with UV is a possibility, the moisture need only be present during a portion of the treatment & applicants initial curing before pore removal (or completion thereof) doesn't require exclusion of oxidants. Further details or heating also applicable to Raman et al's analogous procedures, include useful pressures of atmosphere or sub-atmospheric (vacuum), of using any heating technique, inclusive of hot plates, or radiant or microwave energy, thus further substantiating above stated obviousness. In Hacker, see column 3; lines 5-67+; column 8, lines 9-25; column 9, lines 1-14; column 10, lines 58- columns 11-12, esp. column 11, lines 13-36 and 49- column 12, line 36 and 35-67; and column 13, lines 1-11.

While Hacker (076) teaches a CVD process of interest in & of itself, it doesn't read on applicants' claims 42-45 which specify a CVD process, because its pore & structure formers are one & the same molecule (col.11, lines 1-19), & independent claim 42 requires these to be distinct entities. While Albano et al suggest mixtures that include pore-formers as in claim 45, they are deposited via liquid techniques, so that suggest CVD.

17. Claims 1-4, 10, 12-13, 15, 17, 26-29, 32-35, 37-40 are rejected under 35 U.S.C. 102(a) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Nakata et al (2003/0003288 A1= PN 6,780,498).

Claims 5-9, 11, 16 & 18-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata et al.

Nakata et al teach making a low dielectric constant (K=1.4-2.5) material, that may be porous (desired average pore size 50-200 nm), where a mixture of siloxane and tetraalkoxysilane &/or (alkyl)trialkyloxysilane compounds are mixed with solvent, such as cyclohexane, and an "dissipating agent" or "pore-forming substance", such as an adamantane compound or a phenol compound or various polymers, such as polypropylene, polyester or acrylic resin. The pore formation occurs when solvent is vaporized and the agent "dissipated", via either heating or use of UV light irradiation. Exemplary atmosphere used is N_2 where the amount of O_2 contained in the N_2 is less than 100 ppm (i.e. 0 to <100 ppm, or minimal contamination). Nakata et al teach their process solves the problem caused by hydroscopic SiOH groups ([0017]&[0020]), and teach other resultant groups ([0051]&[0053]) in the films produced, indicating that they are substantially free of Si-OH as required. See the abstract; [0015], [0020], [0028-0037]; [0043-0050] for pore formation; [0053] for K; [0080-83, esp. 0083] for solvent; [0085] for thermal or alternately UV treatment, plus thermal after treatment to further crosslink. Examples 1-6 disclose resin preparations on [0096-0119], where Examples 4-6 are particularly directed to making porous film, then [0120-0125], Ex. 7 provides the most detailed processing Example using

adamantine & N_2 atmosphere essentially without any oxidants, with Table 1, Examples 4-6 providing dielectric constants 2.12-2.16. While Nakata et al do not explicitly state that the UV is done under an N_2 atmosphere, it is the only atmosphere taught for performing the "dissipating", i.e. pore forming step, hence given the discussion on solving the hydroscopic SiOH problem & the types of groups in the product, this taught atmosphere of Nakata would be considered to apply to both the thermal & UV techniques for pore formation. Alternately, it would have been obvious to one of ordinary skill in the art that changing energy source from thermal to photo (UV) does not change the requirements to the chemistry or the teaching of the type of products to be formed, hence it would have been abundantly obvious to the competent practioner to employ a non-reactant, non-oxidizing atmosphere as in Ex. 7, whether one was using the alternatively taught UV or thermal means.

Nakata et al does not discuss apparatus, nor specific UV treatment parameters or sources or distances therefore, however the obviousness of determining such via routine extermination as discussed above, again applies, as it would remain routine for one of ordinary skill in the art to determine the effective UV absorption wavelengths to enable taught dissipation reactions to be preformed. Note while Nakata et al doesn't list any one of the UV conformation options of claim4, as any way the use the UV will read on one of the list, this claim is effectively inherently read on. The compositional formula is also not disclosed as claimed, but is similarly obvious for reasons as discussed above and because overlapping precursor materials with those used by applicant are used in Nakata et al. As the claimed type or use of chambers to hold the process, its gases, etc., are both generic & conventional and would have been modified for the specific processes requirements, they also are obvious variations. The possibilities of having overlap between forming & exposing &/or exposing & treating, would have been further obvious to one of ordinary skill in the art, as the taught UV process can have thermal processing both before & after, and since the UV exposure its self can cause heating, with control of temperature an old and well known means for controlling reaction rates, over lap of at least portions of the phases of the reactions

would have been a useful option to speed up processing depending on the effects on particular reagents used.

Nakata et al do not discuss value for changes in density when pore-formation occurs, however they do teach that desirable porosity is 10% to 70% by volume of pore for the total volume [0050], and while this cannot be translated directly into density without knowing the density of the structure formed and that of the pore-former which was removed, leaving behind the pores, the taught volume % porosity would inherently covers the significantly overlapping range as the claimed densities, and thus read on this limitation. Alternately, it would have been obvious to one of ordinary skill that if the two types of components have roughly similar average densities, then 10%-70% pore volume would correspond to roughly a 10 to 70% decrease in density, and that optimizing for volume % of pore is roughly equivalent to optimizing for decreased density, as either way the resultant product needs to have sufficient mechanical properties as taught. The correspondence of volume % pores to density decrease and compositional effects in the claims and references is especially expected due to the overlap in material that may be employed, and treated by like techniques.

18. Claims 1-30, 32-35 and 37-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raman et al (5,935,646), in view of Albano et al (2003/0054115 A1) as applied to claims 1-12, 14-195, 17-30, 32-35 and 37-41 above, and further in view of Nakata et al as discussed in section 17 above, which cumulatively & explicitly shows the effectiveness of using UV to remove organics & form the pores desired by all references. Also the atmospheric effects teachings of Raman et al & the specific atmosphere used in Nakata et al are also supportive of each other.

19. Other art of interest include Matsushita et al (6,426,235 B1) who irradiates deposited dissolved silica solutions with UV, but produces O_3 in the process, so is clearly using oxidizing atmospheres; Waldfried et al pregrant pubs/patents, which are not prior art, but 2004/0058090 in [0016], [0025] and [0089] have teachings of significant interest, as does 2004/0018319 A1= PN 6,750,085 B2;

Murakami et al (2003/0087042 A1= PN 6,919,106 B2); Colburn et al (6,930,034 B2); Gallagher et al (2004/0137728 A1); Ott et al (2004/01856679 A1); and Albano et al (2002/0106500 A1=PN 6,913,796 B2) are of interest for post-treatment of porous material with UV, plasma or e-beam; and Meinzer et al (5,593,737) for teaching use of UV for drying of solvents (column 3, lines 33-45).

20. Claims 1-9, 12, 15, m20-26, 28-30,32, & 37-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ruepping (6,346,300 B1 or Pachl et al (6,174,932 B1), in view of McCann et al (4,303,695).

While from the specification, the examiner recognizes that applicants do not appear to intend to claim materials as discussed in these patents, the present claims as written lack sufficient context to eliminate foamed organic polymeric coatings as disclosed therein. Ruepping (6,346,300 B1: col.19, lines 34, esp. 57-65-col.20, lines 38, esp. 20-30 35-38) or Pachl et al (6,174,932 B1; col.4, line 41-col.5, line 41; col. 9, lines 17-39 & 50- col.10, lines11+; and col.12, lines 23-27) teach UV curable coatings that may contain a foaming agent (small molecule), which can be decomposed to cause foaming to occur simultaneously with the UV curing, with relevant lamp & curing parameters. The 2 references differ by not requiring that the atmosphere in which the UV treatment takes place be non-oxidizing, however it is an old & well known principle in the UV curing art, that on employs inert atmospheres when the polymeric material being cured may be inhibited by oxygen, as is set forth by McCann et al (4,303,695; col.4, lines 5-15), hence it would have been obvious to one of ordinary skill in the art to employ such inert atmospheres depending on particular polymeric materials to be cured, which may be varied to achieve different product properties.

21. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marianne L. Padgett whose telephone number is (571) 272-1425. The examiner can normally be reached on M-F from about 8:30 a.m. to 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks, can be reached at (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MLP 9/14, 15, 16, 17/2005

MARIANNE PADGETT
PRIMARY EXAMINER